B1

196b) applied along portions of a straight edge of a feature. A negative bias like 196 represents a portion of an opaque area made transparent (or a portion of a window made opaque). In this case the negative bias reduces the size of the item on a mask to avoid generating the spurious feature 182 of Figure 1A. Also shown are assist features 194 (i.e. assist features 194a and 194b), which are separate items smaller than the resolution of the photolithographic process and thus too small to be formed in a photoresist layer, but which are sufficiently large to effect diffraction patterns that influence larger nearby features. The assist features 194 are intended to move the edge 185 of the printed features 180 in Figure 1A toward the outline 171 of the original mask items 170. Also shown is a sub-resolution serif 193 of extra opaque material to compensate for overexposure at convex corners of opaque areas, and an anti-serif 197 indicating where opaque material, if any, is removed to compensate for underexposure at concave corners of opaque polygons. These corrections are listed to illustrate the concepts of correcting a mask to compensate for proximity effects. The illustrated corrections do not necessarily correct the depicted features.

Page 14, lines 9-17 should be replaced with:

B2

The conventional processes include ~~the Functional EDA~~ process 210 that produces the schematic diagram 215. The physical EDA process 220 converts the schematic diagram to a design layout made up of one or more design layers 225 (e.g. design layers 225a, 225b, and 225c). After mask layouts 235 (e.g. mask layouts 235a, 235b, and 235c) are produced, the conventional processes employ a fabrication process 240 to produce the printed features layer 249. The printed features layer 249 may be a layer in a printed circuit or the mask used

to produce the layer in the printed circuit. In the former case, the fabrication process includes one process 243 for forming the mask and a second process 245 to produce the layer of the integrated circuit using the mask. If the printed features layer 249 is the mask, step 245 is skipped.

B2

Page 18, lines 3-10 should be replaced with:

Figure 4C illustrates contours 450a-450g of constant amplitude on a two dimensional array of model output for one kind of proximity effects model, if it were to be run for every point on such an array. One particular contour representing the threshold value, contour 450c, is shown as a bold line. The shapes formed by the bold contour 450c represent this model's prediction of the shape of the printed features accounting for all proximity effects in the system. As can be seen by the bold contour 450c in Figure 4C, this proximity effects model predicts printed features with shapes that agree with those that actually would be produced on the printed features layer, as shown in Figure 4B.

B3

Page 19, lines 1-8 should be replaced with:

The threshold value 470 of about 0.3 model amplitude units corresponds to the value of contour 450c. Where the model output 465 is above the threshold value 470, a feature is predicted to be printed in the printed features layer; where the model output 465 is below the threshold value 470, no feature is predicted to be printed. Where the model output 465 equals the threshold value is where the edge of the printed feature is predicted to lie. Of course model output units are arbitrary and could be inversely related to what is printed, so that low amplitudes represent printed features and

B4

B4

high amplitudes represent no printing. In such a case, the threshold would mark the value below which a feature is printed.

Page 27, lines 2-7 should be replaced with:

B5

The profiles such as 540 can be generated by any method known in the art. In one embodiment, the test patterns used to build the model are used. These test patterns already include a range of features at different scales and model output computed on a relatively dense output grid. Thus with substantially no additional computations than those already made to build the proximity effects model in the first place, model amplitudes along various polygon edges are already available for deriving dissection parameters.

Page 33, line 21 to page 34, line 4 should be replaced with:

B6

Corner, line-end and turn-end dissection lengths are used in those circumstances even if projection points are also present. Projection points control segment lengths in the interior portions of an edge away from the vertices, as will be described later below. Away from corner segments (including all of short edges like line-ends and turn-ends) and projection points, residual portions of an edge are divided evenly so that no segment is greater than Lmax and no segment is shorter than the shorter of Lcor and Ldet. Though controlled by the prescribed dissection parameters Lcor, Ldet and Lmax, the actual length of these segments (dmax)(see dmax 829, for example, in Figure 8D) is derived from the original vertex positions.

Page 35, line 17 to page 36, line 5 should be replaced with:

In the preferred embodiment, dissection in the vicinity of the projection point is carried out by placing a dissection point 830q at the projection point 850 and at two other points 830r and 830s spaced Ldet 822 from the projection point 850. Evaluation points 840m and 840n are then placed at the midpoint of the segments so defined. In another embodiment, an evaluation point is placed at the projection point, and two dissection points spaced Ldet from each other straddle the evaluation point. Such an embodiment is not preferred because it does not allow for different corrections on either side of the projection point as needed for most circumstances, for example, as needed for curve 540 in Figure 5B. In yet another embodiment, the segment centered on the projection point of this previous embodiment is augmented with two additional segments of length Ldet, one each on either side of the first segment. While such an arrangement allows for different corrections near to and on either side of the projection point, it requires three evaluations rather than the two evaluations of the preferred embodiment.

B7

Page 37, lines 1-12 should be replaced with:

In step 916, the edge length L is necessarily greater than double the minimum dissection length, and it is determined whether the edge is long enough to accommodate two corner segments of length Lcor and an intervening segment of length Ldet. If not, the edge is treated as a line end or as a turn-end. In step 918 it is determined whether the edge is a turn end, i.e., includes both a convex corner and a concave vertex. If not, the edge is a line end and dissection points are placed at the two vertices in step 915 and control passes to step 370 to place the evaluation point. If one vertex is a convex vertex and the other is a concave vertex, so that the

B8

edge is a turn-end, it is determined in step 920 whether the edge length L is less than double Ldet. If not, then the edge is split evenly into two segments with dissection points at both vertices and at the mid-point of the edge in step 919. If the edge length L is less than double Ldet, then the edge is kept as one segment with dissection points at the vertices in step 915. In either case, control then passes to step 370 to select evaluation points.

B8

Page 37, lines 13-17 should be replaced with:

If it is determined in step 916 that the edge length is long enough, two corner segments are placed on the edge, by selecting both vertices of the polygon as dissection points as well as selecting the two points spaced away from the two vertices by the distance Lcor in step 922. A residual edge length is computed by subtracting double the corner dissection segment length, i.e., subtracting 2*Lcor, from the edge length L.

B9

Page 38, lines 8-11 should be replaced with:

In step 944 the residual length LR is necessarily greater than or equal to double Ldet, and it is determined whether the residual length LR is also less than triple Ldet. If not, the segment is split evenly into two segments by adding a dissection point in the midpoint of the segment in step 945. If so, control passes to step 946.

B10

Page 40, line 13 to page 41, line 2 should be replaced with:

Figure 10A illustrates two rectangular shifters 1010a and 1010b that form a true-gate 1001 along a portion of the area between the shifters 1010. For example, shifter 1010a is bounded by four edges connecting vertices 1031, 1036, 1037 and

B11

1038. Also shown is a polygon 1020 used in a second exposure to connect the true-gate 1001 to other features, not shown, with connecting features 1009a and 1009b. Edges connecting vertices 1040, 1043, 1045, 1046, 1047 and 1048 are on polygon 1020. The polygon 1020 includes wide trim sections 1024 (i.e. 1024a and 1024b) entirely within the shifters 1010 (i.e. 1010a and 1010b) where there is no material on the layer being exposed the second time. The purpose of the trim sections 1024 is to prevent overexposing the edge of the true-gate 1001 during the second exposure. The edges of the trim sections 1024 inside the shifters 1010 do not leave edges on the printed features layer. For example, no edges are printed corresponding to mask edges connecting vertices 1043 to 1045, 1045 to 1046, and 1046 to 1047. Also, the edges of the shifters outside the trim polygon are not printed. For example, the edge connecting vertex 1038 to vertex 1037 is not printed.

B11

Page 43, lines 14-22 should be replaced with:

Other arrangements yield other results. For example, Figure 10B shows an arrangement that has one edge of true-gate 1002 formed by a portion of one edge of polygon 1021, between vertices 1054f (of trim section 1025a) and 1054g (of trim section 1025b). The true gate corners on this edge are at points 1055a and 1055b. Both of these true-gate corners are also intersections of the shifters 1011 with this edge of the polygon 1021. Whether this edge is further dissected depends on the distance between these corners. If the distance from 1055a to 1055b is less than the minimum segment length, e.g., the lesser of Lcor and Ldet, then this edge of the polygon 1021, between vertices 1054f and 1054g, is not dissected; and no evaluation point is placed on this edge.

B12

Page 45, line 23 to page 46, line 2 should be replaced with:

B13

Figure 10C shows shifters 1012 shared across two true-gates 1003 that are not connected to each other. For each true-gate, a polygon 1022 provides a connector 1009 to other elements, not shown, trim regions 1026, and an end cap 1090. For example, polygon 1022a provides connector 1009d, trim regions 1026a and 1026b, and end cap 1090a, whereas polygon 1022b provides connector 1009f, trim regions 1026c and 1026d, and end cap 1090b.

Page 49, line 15 to page 50, line 2 should be replaced with:

B14

In another embodiment, the adjusted fabrication layout is tested again with the proximity effects model to determine whether the agreement between the printed features layer (249 in Figure 2) and the design layout (225 in Figure 2) satisfy a pre-defined specification tolerance. If so, the corrections end. Otherwise, another round of corrections is performed based on the current correction to further improve the agreement. This process iterates until the agreement converges on the specified tolerance for all edges, or it is determined that further improvement is not possible. In this embodiment, the recently adjusted fabrication layout produced during process 236 becomes the next proposed fabrication layout (231) and the processes 260 through 236 are repeated. For example, dissection points and evaluation points are selected for the new proposed layout, printed features are predicted with the model, and the differences are analyzed.